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Complex Geographical Analysis of the Greater Sochi Region on the Black Sea Coast

Rybak, Elena A., Dr.; Rybak, Oleg O., Dr.; Zasedatelev, Yuri V., Dr., Scientific Research Centre of the Russian Academy of Sciences, 8-a Theatralnaya Street, Sochi 354000, Russia

ABSTRACT: Results of the complex analysis of the unique natural territory of Greater Sochi from the point of view of physical geography are considered. The region of Greater Sochi is located on the S slopes of the Main Caucasus chain on the eastern coast of the Black Sea. Morphometrical analysis of the relief and analysis air surface temperature and precipitation allowed to distinguish four specific subregions within the whole territory. It is demonstrated that the period of stable snow cover in the two subregions which occupy more than half of the region's area is sufficient for successful development of winter tourism. Peculiar combination of the mild climate of the coast with stable snow cover in the mountains till the beginning of summer provide strong attractivity of the region for all-the-year-round tourists inflow to the most modern recreational centre of Russia. The work provides the methodology for similar studies.

Introduction

It was the beginning of 1920s when the geography of tourism was pioneered. The rapid development of tourist industry between the two World Wars and in the postwar decades triggered numerous systematic theoretical elaborations and regional researches. "The regional approach weaves the systematic elements of a location to account for its regional character, the one ingredient that distinguishes destinations from each other. The search for regional diversity in the landscape has remained an important motive for travellers, despite the standardisation and homogenisation of tourist industry" (Mitchell, Murphy 1991). The genuine determination reflects the main goal of a regional geographical research. The number of publications aimed at geography of tourism increases from year to year, and 75% of the papers originate with European geographers (Mathley 1976). We may state now that regionalistics has escaped into an independent branch of geography.

In the above context seashore health-resorts are of particular interest. They have traditionally attracted the greatest number of people. A specific situation has arisen in Russia after the decay of the Soviet Union. The only seashore region with rather warm climate and health-resort specialisation is the Black Sea coast from the Straight of Kerch to the border with Georgia. Though the region economy has recreational orientation, its potential is relatively low with the exception of Sochi, the latter being the most fashionable tourist centre in Russia today with a developed infrastructure and rather diversed services.

In the current research we expound the results of the analysis of recreational potential of the Greater Sochi region from the point of view of physical geography. For this purpose we examined the peculiarities of climate and relief of this unique territory.

Greater Sochi is located on the S slopes of the Main Caucasian chain on the E coast of the Black Sea (Fig 1). Its area equals to 3,500 km^2 and the permanent population amounts to 370,000 inhabitants. The overwhelming part of population inhabits the narrow strip along the coast. Small settlements are located in the valleys of the numerous rivers. Population density in the urbanised part of the city (the latter does not exceed 6%) amounts to 500–2000 inhabitants/km^2. The rural part of the territory (nearly 25%) is populated much more sparsely. Population density averages here to 50 inhabitants/km^2 approximately. The rest of the territory (69%) is unpopulated (Fig 2). Various natural landscapes have left virginal deciduous and coniferous forests, alpine meadows, etc. The absence of big industrial installations has allowed to maintain fairly sound ecological conditions.

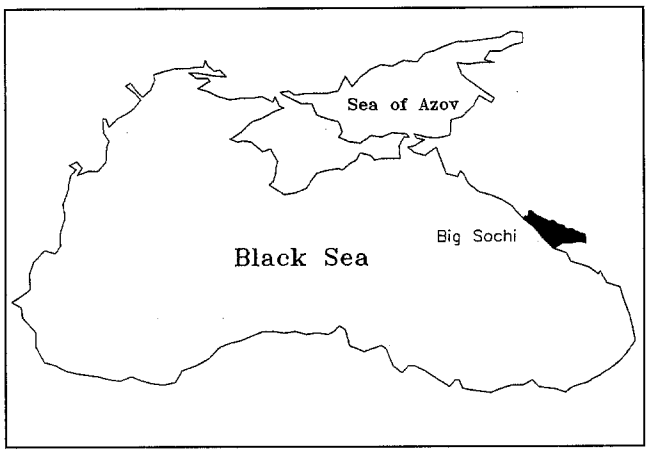


Fig 1 Location of the Greater Sochi region

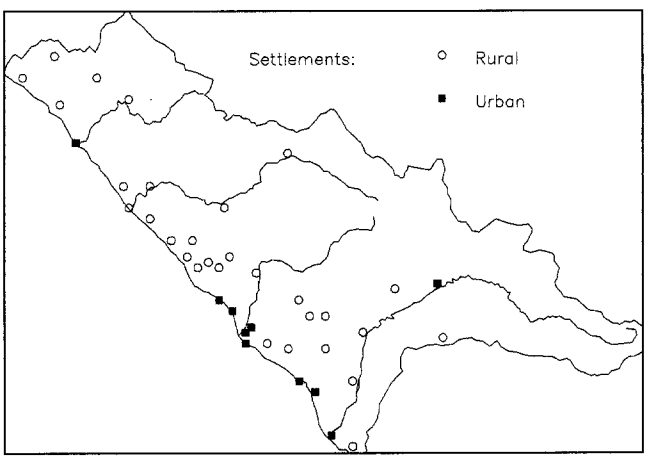


Fig 2 Main towns and settlements on the territory of the Greater Sochi

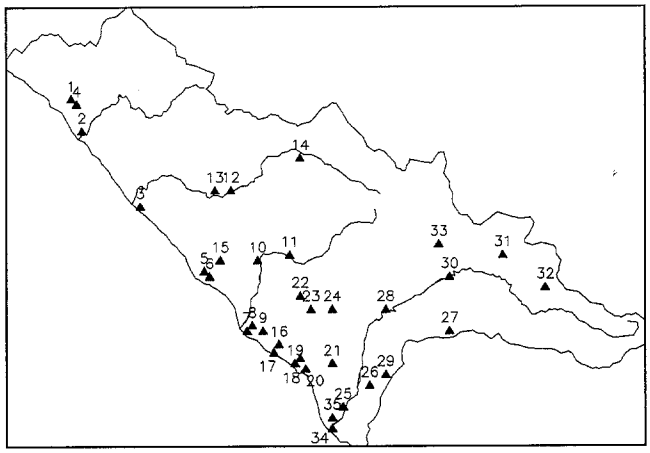


Fig 3 Meteorological stations on the territory of the Greater Sochi region:

1 - Ashe
2 - Lazarevskoye
3 - Shakhe
4 - Mamedova Shel
5 - Uch-Dere
6 - Dagomys
7 - Sochi (Seaport)
8 - Sochi (Observatory)
9 - Blagodat
10 - Plastounka
11 - Azhek
12 - Solokh-Aoul
13 - Tuukh-Aoul
14 - Babuk-Aoul
15 - Volkovka
16 - Old Matsesta
17 - New Matsesta
18 - Nizhni Akhun
19 - Verkhni Akhun
20 - Khosta
21 - Verkhnaya Nikolajevka
22 - Semionovka
23 - Kalinovoye Ozero
24 - Vorontsovka
25 - Moldavanskoye
26 - Nizhnaya Shilovka
27 - Aibga
28 - Kepsh
29 - Yermolovka
30 - Krasnaya Polyana
31 - Laura
32 - Psloukh
33 - Achishkho
34 - Adler
35 - Airport

The Black Sea coast of the Caucasus was annexed to the Russian Empire after the Russian-Turkish war in 1828. The city of Sochi was founded in 1837 as a military fortification. It was in 1898 when the Special State Commission decided to utilize the uniqueness of the region and its perfect fitness as a health resort. Thorough and comprehensive examination of the mineral springs, the climatic peculiarities and the geologic structure of the coast preceded this event.

This development resulted in increasing real estate prices in the surroundings of the town of Sochi. A period of a building boom began: many persons of high rank and businessmen started constructing summer cottages, hotels and boarding-houses. The building has become even more active after the Novorossisk-Soukhum highway connecting the region with the central parts of the Empire, reached the town.

There were 14 hotels, 2 clubs, a library, and a hospital in the town in the very beginning of the XXth century. In 1902, Dr. V. F. Podgourski opened the first hydropathic establishment in the valley of the Matsesta river. In 1909, the first real resort complex "Caucasian Riviera", consisting of four hotels, a restaurant, a theatre, a hydropathic and an electric power station, was inaugurated.

After the October overturn in 1917 the whole resort complex of Sochi was nationalized. At that time about 4,500 people visited the town annually. From the beginning of the 1920s the Soviet State has supported the development of the recreational potential in the region. Rich investments resulted in essential growth of number of people, visiting Sochi: 110,000 in 1940. During World War II the greatest military hospital complex was established in Sochi on the basis of existing hotels and sanatoria.

In the early 1960s the coastal strip of 146 km in length with several towns, some tens of villages, and the city of Sochi were organized in a new administrative unit - Greater Sochi. The region enjoyed rapid growth since the beginning of 1930s owing to generous state subsidies. As a result, the city has turned into the flourishing health-resort receiving 4,000,000 tourists annually including 200,000 from abroad.

The influx of tourists decreased abruptly, however, after the artificial maintenance of the tourist industry had ceased and the country had turned to the market economy. The tourist low corresponds basically to the period from November to April ie "dead season". The balneological potential, numerous mineral springs and the service infrastructure alone do not attract people to provide sufficient employment for the local inhabitants.

At the same time the region's potential for winter tourism is not used although the city has pretended to conduct the Olympic Winter Games in 1988.

Greater Sochi is unique in terms of its nature and climate. It is an area where different natural zones meet from the moist subtropics on the narrow coastal strip to eternal snow and glaciers of the Main Caucasus chain. These zones are quite close to each other, only several tens of kilometres apart. Such combinations are rare on Earth.

It is worth mentioning that the salinity of the sea water near the Caucasian coast is 16–18 grams/litre, a value most comfortable for the human organism.

The diversity of the natural conditions provides prerequisites for a year-round tourist season.

Climate

Regular meteorological observations have been conducted in the area since 1891, while some meteorological elements had been observed even earlier. Up to fifty meteorological stations have existed in the region during the last century (Fig 3).

The climate of the Black Sea coast depends on the characteristics of air masses, and, to a great extent, on the peculiarities of the relief.

The Black Sea is influenced by various air masses in different seasons: polar (continental and marine), and tropical. The most frequent is continental polar air, which predominates during half of the year. Tropical air holds the second place.

Continental polar air invades the Black Sea with strong NE wind. It is dry and clear and is responsible for abrupt cooling, abundant cloudiness, frequent and plenty precipitation. It is most frequent in January and in February.

Marine polar air originates from the Atlantic Ocean. It is very unstable, and, as a consequence, produces convective cloud and squally precipitation.

Marine tropical air is geared by the Azor Maximum and invades the Black Sea from the Mediterranean. In winter, such transitory cyclonic invasions are accompanied by unstable weather with strong winds of S and SW directions. In summer, the Black Sea region is almost all the time under the influence of the Azor Maximum. It then provides stable weather with a great number of clear days, and genuine breeze circulation from May till October.

Invasions of continental tropical, marine and continental arctic air masses are quite rare, so their role in forming the climate is negligible.

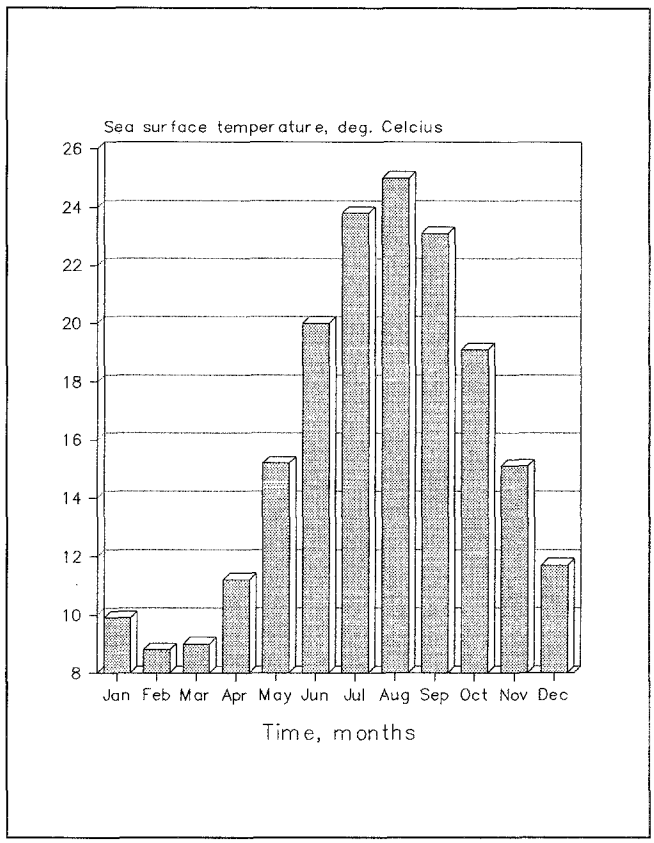


Fig 4 Mean monthly sea surface temperature (°C) at the shores of the Greater Sochi (1949–1989)

Close to the sea which possesses an enormous thermal inertia the climate is very much softened. For the monthly means of sea surface temperature (SST) in Sochi for the period of 1949–1988 see Fig 4. The annual mean equals to 16 °C, the maximum is observed in August (25 °C), the minimum in February (<9 °C). The mean daily SST is higher than the air temperature (AT) by 2.3 °C, (excluding April and May, when AT is higher by 0.7 °C) (cf. Fig 10a).

Altitudinal Climatic Zonality and Relief

Microclimatic Peculiarities

The diversity of natural conditions have caused microclimatic perculiarities. The relief is basically responsible for the regime of temperature and precipitation. Air temperature is influenced by (besides absolute height and the distance from the sea shore) the slope angle, slope orientation and the angle at which the horizon is hidden by neighbouring mountains as Barry (1984) has demonstrated in the Alps at 400 m asl and clear sky, N slopes with inclination of 30° obtained 57% of the solar radiation compared to a horizontal plane. At the same time, S-facing slopes obtained 126%.

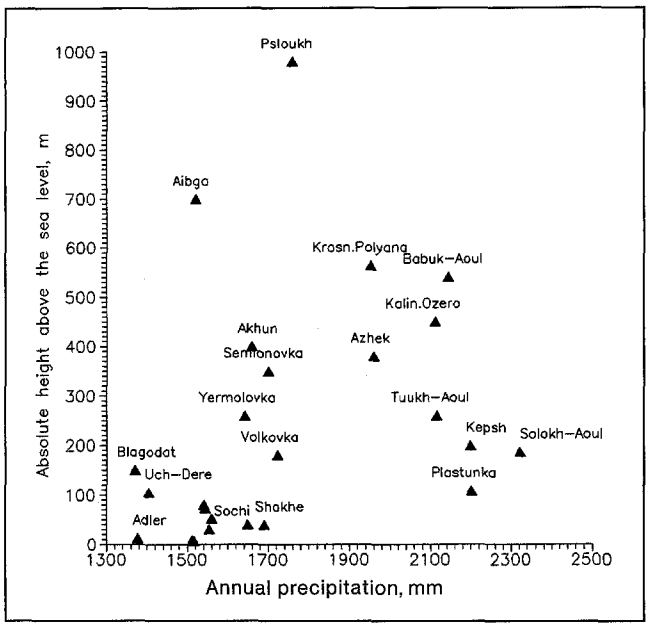


Fig 5 Annual mean precipitation (mm) at different absolute heights

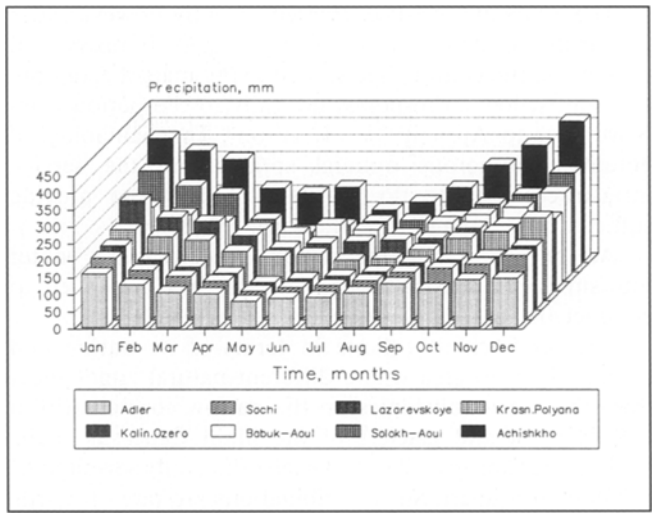


Fig 6 Average seasonal trend in precipitation (mm)

The head balance is less sensible to the radiation of the surface (albedo and emissive capability) unless when covered with snow or ice. The greatest disparities appear in winter when N slopes receive only 30% of the radiation incoming of S ones (Barry 1984), resulting in differences in air temperatures at N and at S slopes amounting to 1 °C, and in soil surface temperatures up to 5 °C (Selyaninov 1936).

Distribution of annual precipitation (P) in the mountains is characterised by strong diversity and by strong dependence on the orographic conditions. Besides of the absolute height above sea level the precipitation is influenced by the relative height of a barrier, which may have overcome by an air flow, and by the angle at which a flow approaches to the barrier. The prevailing direction of winds (S and SW) is nearly perpendicular to the axes of the main mountain chains. Thus the location of the point where precipitation is measured - in front of the barrier or beyond - is decisive for the amount of precipitation. The phenomenon of "rain shadow" (characterised by decreasing P at the same absolute height beyond the obstacle) is observed beyond the barrier. The above diversity is illustrated by Fig 5. Obviously, the absolute height of the station is not decisive: for example, Psloukh (980 m) P = 1761 mm, and Slokh-Aoul (190 m) P = 2321 mm. "Barrier" effect and "rain shadow" effect are peculiar for the greater part of stations. The seasonal changes at different stations are quite alike (Fig 6).

To estimate the changes of climatic conditions within Greater Sochi, to clarify the relation of the latter with orography, and to review the peculiarities of the relief from the quantitative point of view, the morphometrical analysis of the relief was conducted in accordance with a method worked out by Anisimov (1987), and Anisimov and Zasedatelev (1993). It consists in comprehensive and complex examination of the following parametres: exposition, slope inclination, horizontal and vertical dissection and height asl. All the parameters were averaged within 2 x 2 km elementary squares (approximately 1,000 in total). Additional examination has confirmed that such division is sufficient to give a rather detailed description of the relief peculiarities of the territory. For example, the diagram of mean absolute heights (Fig 7) is consistent with river tributaries beginning with the 3rd order according to the Horton classification (Horton 1945).

The data on the snow cover duration were generalised and bound with thermal and orographical characteristics of every elementary square. The empirical curve reflecting the dependence of the duration on the absolute height is shown in Fig 8. The distribution of the duration of the snow cover on the city territory being dependent on the absolute height is shown by Fig 9.

After generalizing the climatic and orographic data, four specific subregions within the city territory are distinguished. They are described below. The respective peculiarities of soils and vegetation are out of the scope in this study, such examination, however, is now being conducted.

Coastal Subregion

The climate of the narrow strip limited by the foothills of the Main Caucasus chain is close to marine subtropical. The Main Caucasus chain defends the city from the cold air masses penetrating from the North. On the other hand, mountains are responsible for the forced convection in air masses flowing from the South, and, as a consequence, for abundant precipitation. The annual amount of precipitation gradually increases from the NW to the SE of

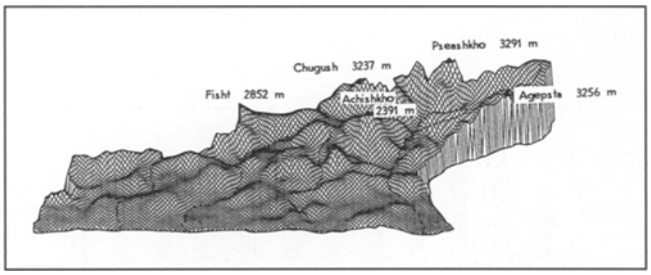


Fig 7 Diagram of mean absolute heights

the entire Black Sea coast of the Caucasus: nearly 700 mm in Anapa, approximately 2,500 mm in Batumi.

Similar climatic conditions are observed on Eastern coasts of South Africa, Australia and Japan.

Thermal characteristics of the coast are displayed by Fig 10a. By Fig 11a the ratio between liquid, solid and mixed types of precipitation is shown. Conditions along the coast are quite uniform, so the observations at Sochi characterise the whole coastal strip quite well.

Subtropical climate is traced up to the height of 200 m asl. Hills with gentle slopes of 5°–10° prevail. This region has lost its original appearance under the influence of industrial activities. The peak of tourist inflow is observed in summer, especially in July and August.

Subregion of the Low-Mountain Relief

The region of the low mountain relief occupies the territory within 200–600 m asl. It consists of ridges with mainly gentle slopes of sub-latitudal orientation, divided by river valleys. The slopes' inclination does not exceed 20°, dissection (both vertical and horizontal) is weak. The region is characterised by more severe winter conditions, the average January temperature being lower by 2°–3 °C than on the coast (Fig 10b).

The dry-adiabatic lapse rate averages at 0.6 °C/100 m. Thus the decrease of the surface air temperature versus the increase of the absolute altitude is somewhat more intensive than in the standard atmosphere due to diminishing of the heating influence of the Black Sea. The thermal conditions of the region are sufficient for the formation of a stable snow cover for 50–65 days at the upper boundary of the region.

Subregion of the Middle Mountains

The region of the middle mountains occupies altitudes ranging from 600 to 1800 m asl. This territory totals to 44% of the city area. It consists of gentle mountain ridges of different orientation and the upper parts of the valleys of the rivers Shakhe, Psezuapse, Sochi, and Mzymta. The slopes' inclination averages around 20°–25°, horizontal dissection equals to 1.5–2 km/km^2.

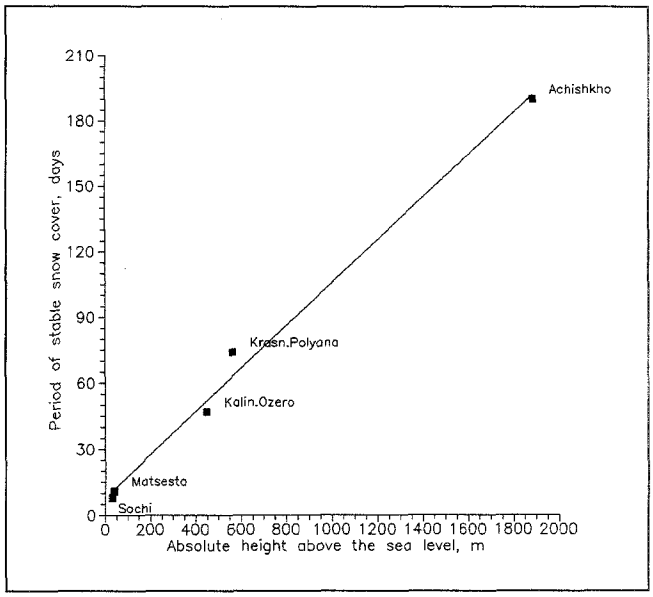
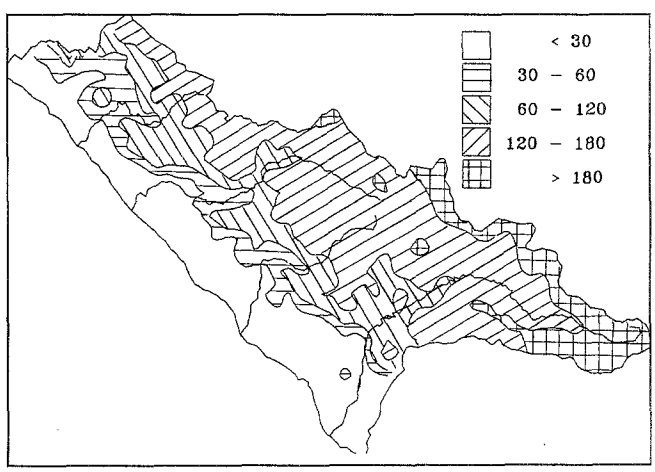


Fig 8 Empirical dependence of stable snow cover duration (days) on the absolute height of the place (m)

Climatically, the region is characterised by warm summers and relatively mild winters. The population here is sparse, and meteorological stations providing the full set of observations are absent. We use the data of Krasnaya Polyana (564 m) station located at the lower boundary of the region to describe the climate of the region. Monthly mean air temperatures in December, January and February equal to 2.2 °C, 0.3 °C and 1.3 °C respectively (Fig 10c). Solid precipitation is observed from October till May (Fig 11c).

Air temperature at 10 cm above ground was lower than in the meteorological box at the standard height for no less than 2 °C when the relative humidity was no less than 70% (Mosiyash, Lugavtsov 1962). Thus the real temperature in the near surface layer supports the stability of the snow cover for 74 days on average. The 100-

Fig 9 Map of duration of the stable snow cover (days) in the Greater Sochi region



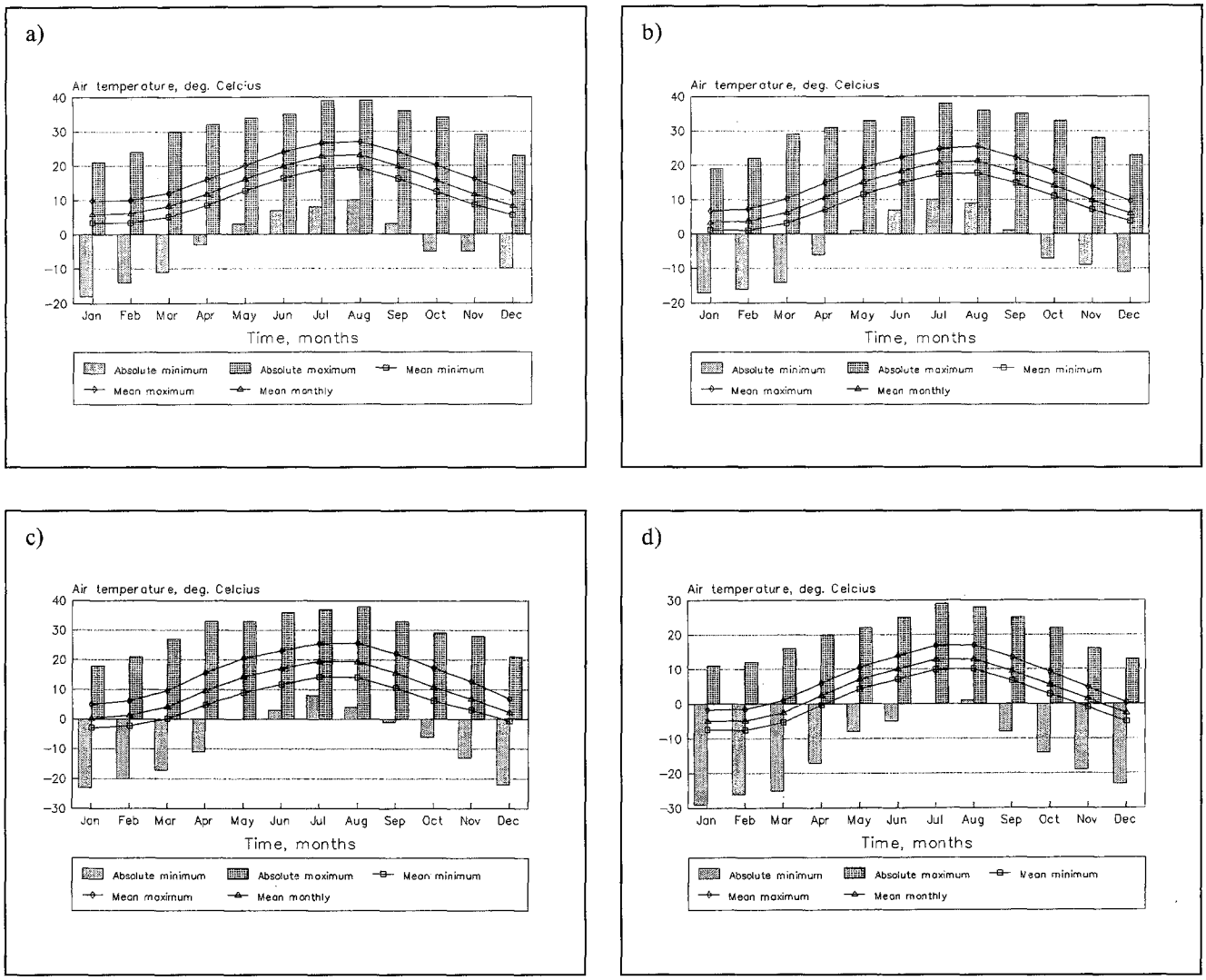


Fig 10 Monthly mean surface air temperature characteristics of specific subregions
a) Coastal: Observatory of Sochi (1891–1980)
b) Low-mountain: Kalinovoye Ozero (1935–1980)
c) Middle mountains: Krasnaya Polyana (1914–1980)
d) High mountains: Achishkho (1930–1980)

days boundary is reached at the height of 800 m. The snow cover remains for 10–30 days longer on the north-facing slopes (Barry 1984). The ten-days mean heights of the snow cover at stations Krasnaya Polyana and Achishkho are demonstrated at Fig 12. The above climatic conditions are apparently favourable of winter tourism and sports.

Subregion of High Mountain Relief

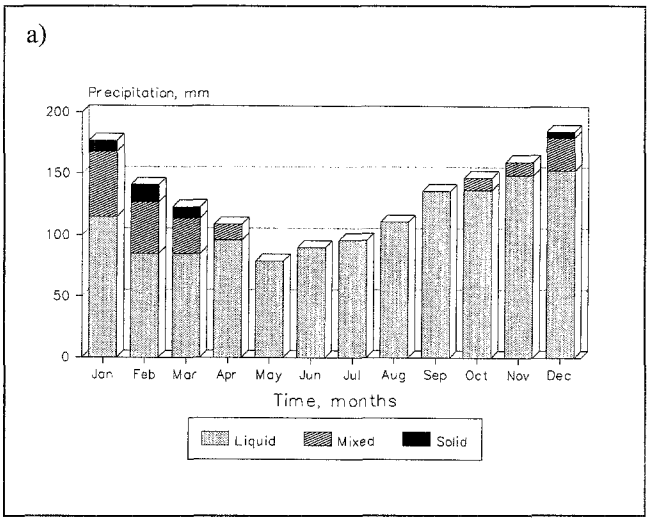
The high mountain relief region consists of watershed areas, the highest mountain ranges, and sections of slopes above 1800 m. Its mastering is quite perspective but very difficult. Slopes exceed 25 °C in inclination and the vertical dissection is high, too (up to 750 m km). Temperature conditions in winter are quite comfortable. Mean monthly temperature from December to March ranges from −2 °C to −5 °C (Fig 10d), and the air humidity is lower than along the coast. Solid type of precipitation prevails (Fig 11d). Stable snow cover remains over half a year (190 days at Achishkho station), and the height of snow cover exeeds 4 m at the end of March.

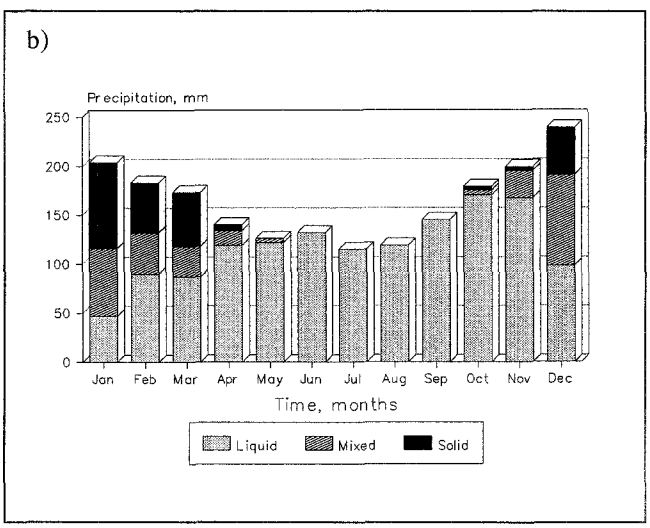
Concluding Remarks

Generally speaking, geography of tourism has been developed in two directions:

1. examination of large-scale problems: studying the dynamics of tourist streams, specialization of large regions, etc.
2. complex studies focussed on the physical geography of small regions.

Geography remains the most descriptive discipline among other natural sciences. "Today geography is a highly pluralistic discipline with no single dominant perspective or philosophical approach" (Mitchell, Murphy 1991).





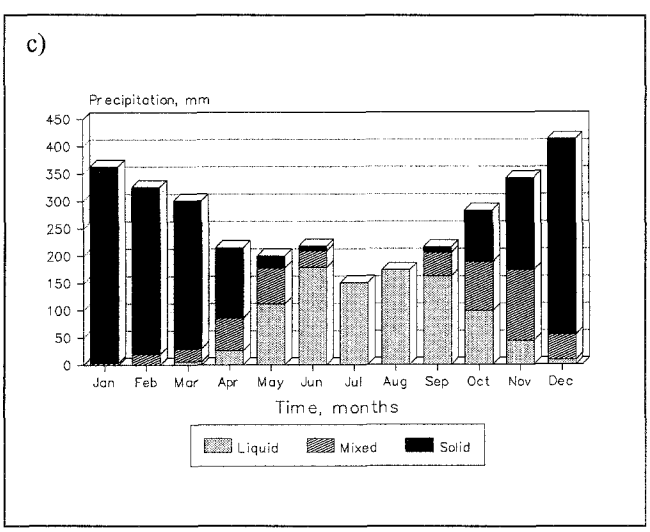


Fig 11 Ratio of liquid, solid and mixed types of precipitation in specific subregions
a) Coastal: Observatory of Sochi (1891–1980)
b) Middle mountains: Krasnaya Polyana (1902–1980)
c) High mountains: Achishkho (1926–1980)

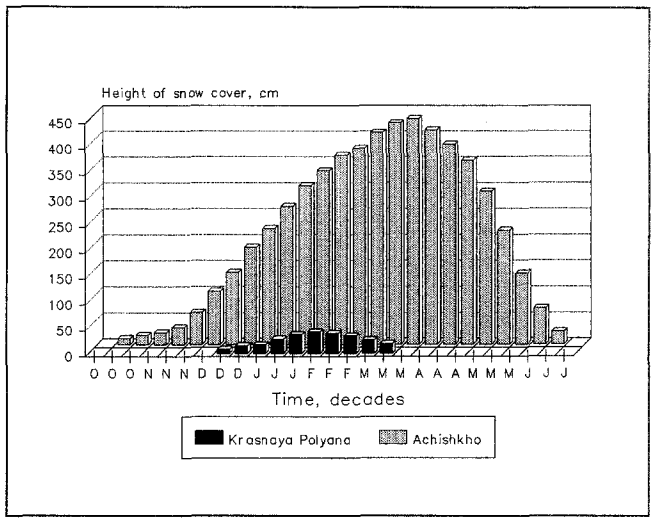


Fig 12 Ten-days average heights of snow cover (cm) at Krasnaya Polyana (1910–1980) and Achishkho (1930–1980)

Nevertheless it is the only discipline providing the generalisation at the regional level, able to offer a forecast for a specified region and the elaborate recommendations aimed at optimum management of the territory.

Complex physical-geographical analysis of the Greater Sochi territory was fulfilled for the first time on the specified level of detailisation.

Geographical location of the region, characteristics of dominating air masses, and peculiarities of the relief are responsible for the formation of diversified subregions within the territory. Diversity of the natural conditions provide good opportunities for intensive tourism industry. So far, winter tourism has not been really developed although the climatic conditions in the middle mountain subregion are best fitted for winter sports during almost all "dead season".

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